TITLE OF THE INVENTION

Vehicles particularly useful as VTOL vehicles.

FIELD AND BACKGROUND OF THE INVENTION

The present invention relates to vehicles, and particularly to Vertical Take-Off and Landing (VTOL) vehicles having multi-function capabilities.

VTOL vehicles rely on direct thrust from propellers or rotors, directed downwardly, for obtaining lift necessary to support the vehicle in the air. Many different types of VTOL vehicles have been proposed where the weight of the vehicle in hover is carried directly by rotors or propellers, with the axis of rotation perpendicular to the ground. One well known vehicle of this type is the conventional helicopter which includes a large rotor mounted above the vehicle fuselage. Other types of vehicles rely on a multitude of propellers that are either exposed (e.g., unducted fans), or installed inside circular cavities, shrouds, ducts or other types of nacelle (e.g., ducted fans), where the flow of air takes place inside ducts. Some VTOL vehicles (such as the V-22) use propellers having their axes of rotation fully rotatable (up to 90 degrees or so) with respect to the body of the vehicle; these vehicles normally have the propeller axis perpendicular to the ground for vertical takeoff and landing, and then tilt the propeller axis forward for normal flight. Other vehicles use propellers having nearly horizontal axes, but include aerodynamic deflectors installed behind the propeller which deflect all or part of the flow downwardly to create direct upward lift.

A number of VTOL vehicles have been proposed in the past where two or four propellers, usually mounted inside ducts (i.e., ducted fans), were placed forwardly of, and rearwardly of, the main payload of the vehicle. One typical example is the Piasecki VZ-8 'Flying Jeep' which had two large ducts, with the pilots located to the sides of the vehicle, in the central area between the ducts. A similar configuration was used on the Chrysler VZ-6 and on the CityHawk flying car. Also the Bensen 'Flying Bench' uses a similar arrangement. The Curtiss Wright VZ-7 and the Moller Skycar use four, instead of two, thrusters where two are located on each side (forward and rear) of the pilots and the payload, the latter being of fixed nature at the center of the vehicle, close to the vehicle's center of gravity.

The foregoing existing vehicles are generally designed for specific functions and are therefore not conveniently capable of performing a multiplicity of functions.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a vehicle of a relatively simple inexpensive construction and yet capable of performing a multiplicity of different functions.

According to the present invention, there is provided a vehicle, comprising: a fuselage having a longitudinal axis and a transverse axis; at least one lift-producing propeller carried by the fuselage on each side of the transverse axis; a pilot's compartment formed in the fuselage between the lift-producing propellers and substantially aligned with the longitudinal axis; and a pair of payload bays formed in the fuselage between the lift-producing propellers and on opposite sides of the pilot's compartment.

According to further features in the preferred embodiments of the invention described below, each of the payload bays includes a cover deployable to an open position providing access to the payload bay, and to a closed position covering the payload bay. In some described preferred embodiments, the cover of each of the payload bays is pivotally mounted to the fuselage along an axis parallel to the longitudinal axis of the fuselage at the bottom of the respective payload bay, such that when the cover is pivoted to the open position it also serves as a support for supporting the payload or a part thereof in the respective payload bay.

Various embodiments of the invention are described below, wherein the lift propellers are ducted or unducted fans, and wherein the fuselage carries a pair of the lift producing propellers on each side of the transverse axis, a vertical stabilizer at the rear end of the fuselage, or a horizontal stabilizer at the rear end of the fuselage.

Several preferred embodiments are also described below wherein the fuselage further carries a pair of pusher propellers at the rear end of the fuselage, on opposite sides of the longitudinal axis. In the described embodiments, the fuselage carries two engines, each for driving one of the lift-producing propellers and pusher propellers with the two engines being mechanically coupled together in a common transmission. In one described preferred embodiment, the two engines are located in engine compartments in pylons formed in the fuselage on opposite sides of its longitudinal axis. In another described

embodiment, the two engines are located in a common engine compartment aligned with the longitudinal axis of the fuselage and underlying the pilot's compartment.

One preferred embodiment is described wherein the vehicle is a vertical take-off and landing (VTOL) vehicle and includes a pair of stub wings each pivotally mounted under one of the payload bays to a retracted, stored position, and to an extended, deployed position for enhancing lift. Another embodiment is described wherein the vehicle includes a flexible skirt extending below the fuselage enabling the vehicle to be used as, or converted to, a hovercraft for movement over ground or water. A further embodiment is described wherein the vehicle includes large wheels attachable to the rear end of the fuselage for converting the vehicle to an all terrain vehicle (ATV).

As will be described more particularly below, a vehicle constructed in accordance with the foregoing features may be of a relatively simple and inexpensive construction capable of conveniently performing a host of different functions besides the normal functions of a VTOL vehicle. Thus, the foregoing features enable the vehicle to be constructed as a utility vehicle for a large array of tasks including serving as a weapons platform; transporting personnel, weapons, and/or cargo; evacuating medically wounded, etc., without requiring major changes in the basic structure of the vehicle when transferring from one task to another.

According to further features in the preferred embodiments of the invention described below an alternative vehicle arrangement is described wherein the vehicle is relatively small in size, having insufficient room for installing a cockpit in the middle of the vehicle and where the pilot's cockpit is therefore installed to one side of the vehicle, thereby creating a large, single payload bay in the remaining area between the two lift-producing propellers.

Further features and advantages of the invention will be apparent from the description below.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is herein described, by way of example only, with reference to the accompanying drawings, wherein:

Fig. 1 illustrates one form of VTOL vehicle constructed in accordance with present invention with two ducted fans;

Fig. 2 illustrates an alternative construction with four ducted fans;

Fig. 3 illustrates a construction similar to Fig. 1 with free propellers, i.e., unducted fans;

Fig. 4 illustrates a construction similar to Fig. 2 with free propellers;

Fig. 5 illustrates a construction similar to that of Fig. 1 but including two propellers, instead of a single propeller, mounted side-by-side in a single, oval shaped duct at each end of the vehicle;

Figs. 6a, 6b and 6c are side, top and rear views, respectively, illustrating another VTOL vehicle constructed in accordance with the present invention and including pusher propellers in addition to the lift-producing propellers;

Fig. 7 is a diagram illustrating the drive system in the vehicle of Figs. 6a – 6c;

Fig. 8 is a pictorial illustration of a vehicle constructed in accordance with Figs. 6a – 6c and 7;

Fig. 8a – 8d illustrate examples of various tasks and missions capable of being accomplished by the vehicle of Fig. 8;

Figs. 9a and 9b are side and top views, respectively, illustrating another VTOL vehicle constructed in accordance with the present invention;

Fig. 10 is a diagram illustrating the drive system in the vehicle of Figs. 9a and 9b;

Figs. 11a and 11b are side and top views, respectively, illustrating a VTOL vehicle constructed in accordance with any one of Figs. 6a – 10 but equipped with deployable stub wings, the wings being shown in these figures in their retracted stowed positions;

Fig. 11c and 11d are views corresponding to those of Figs. 11a and 11b but showing the stub wings in their deployed, extended positions;

Fig. 12 is a perspective rear view of a vehicle constructed in accordance with any one of Figs. 6a – 10 but equipped with a lower skirt for converting the vehicle to a hovercraft for movement over ground or water; and

Fig. 13 is a perspective rear view of a vehicle constructed in accordance with any one of Figs. 6a – 10 but equipped with large wheels for converting the vehicle for ATV (all terrain vehicle) operation.

Figs. 14a-14e are a pictorial illustration of an alternative vehicle arrangement wherein the vehicle is relatively small in size, having the pilot's cockpit installed to one side of the vehicle. Various alternative payload possibilities are shown.

Fig. 15 is a pictorial illustration of a vehicle constructed typically in accordance with the configuration in Figs. 14a-14e but equipped with a lower skirt for converting the vehicle to a hovercraft for movement over ground or water.

It is to be understood that the foregoing drawings, and the description below, are provided primarily for purposes of facilitating understanding the conceptual aspects of the invention and various possible embodiments thereof, including what is presently considered to be a preferred embodiment. In the interest of clarity and brevity, no attempt is made to provide more details than necessary to enable one skilled in the art, using routine skill and design, to understand and practice the described invention. It is to be further understood that the embodiments described are for purposes of example only, and that the invention is capable of being embodied in other forms and applications than described herein.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

As indicated earlier, the present invention provides a vehicle of a novel construction which permits it to be used for a large variety of tasks and missions with no changes, or minimum changes, required when converting from one mission to another.

The basic construction of such a vehicle is illustrated in Fig. 1, and is therein generally designated 10. It includes a fuselage 11 having a longitudinal axis LA and a transverse axis TA. Vehicle 10 further includes two lift-producing propellers 12a, 12b carried at the opposite ends of the fuselage 11 along its longitudinal axis LA and on opposite sides of its transverse axis TA. Lift-producing propellers 12a, 12b are ducted fan propulsion units extending vertically through the fuselage and rotatable about vertical axes to propel the air downwardly and thereby to produce an upward lift.

Vehicle 10 further includes a pilot's compartment 13 formed in the fuselage 11 between the lift-producing propellers 12a, 12 and substantially aligned with the longitudinal axis LA and transverse axis TA of the fuselage. The pilot's compartment 13 may be dimensioned so as to accommodate a single pilot or two (or more) pilots, as shown, for example, in Fig. 6a.

Vehicle 10 illustrated in Fig. 1 further includes a pair of payload bays 14a, 14b formed in the fuselage 11 laterally on the opposite sides of the pilot's compartment 13 and between the lift-producing propellers 12a, 12b. The payload bays 14a, 14b shown in Fig. 1 are substantially flush with the fuselage 11, as will be described more particularly below with respect to Figs. 6a – 6c and the pictorial illustration in Figs. 8a – 8d. Also described below, particularly with respect to the pictorial illustrations of Figs. 8a – 8d, are the wide variety of tasks and missions capable of being accomplished by the vehicle when constructed as illustrated in Fig. 1 (and in the later illustrations), and particularly when provided with the payload bays corresponding to 14a, 14b of Fig. 1.

Vehicle 10 illustrated in Fig. 1 further includes a front landing gear 15a and a rear landing gear 15b mounted at the opposite ends of its fuselage 11. In Fig. 1 the landing gears are non-retractable, but could be retractable as in later described embodiments. Aerodynamic stabilizing surfaces may also be provided, if desired, as shown by the vertical stabilizers 16a, 16b carried at the rear end of fuselage 11 on the opposite sides of its longitudinal axis LA.

Fig. 2 illustrates another vehicle construction in accordance with the present invention. In the vehicle of Fig. 2, therein generally designated 20, the fuselage 21 is provided with a pair of lift-producing propellers on each side of the transverse axis of the fuselage. Thus, as shown in Fig. 2, the vehicle includes a pair of lift-producing propellers 22a, 22b at the front end of the fuselage 21, and another pair of lift-producing propellers 22c, 22d at the rear end of the fuselage. The lift-producing propellers 22a – 22d shown in Fig. 2 are also ducted fan propulsion units. However, instead of being formed in the fuselage 21, they are mounted on mounting structures 21a – 21d to project laterally of the fuselage.

Vehicle 20 illustrated in Fig. 2 also includes the pilot's compartment 23 formed in the fuselage 21 between the two pairs of lift-producing propellers 22a, 22b and 22c, 22d, respectively. As in the case of the pilot's compartment 13 in Fig. 1, the pilot's compartment 23 in Fig. 2 is also substantially aligned with the longitudinal axis LA and transverse axis TA of the fuselage 21.

Vehicle 20 illustrated in Fig. 2 further includes a pair of payload bays 24a, 24b formed in the fuselage 21 laterally of the pilot's compartment 23 and between the two pairs

of lift-producing propellers 22a – 22d. In Fig. 2, however, the payload bays are not formed integral with the fuselage, as in Fig. 1, but rather are attached to the fuselage so as to project laterally on opposite sides of the fuselage. Thus, payload bay 24a is substantially aligned with the lift-producing propellers 22a, 22c on that side of the fuselage; and payload bay 24b is substantially aligned with the lift-producing propellers 22b and 22d at that side of the fuselage.

Vehicle 20 illustrated in Fig. 2 also includes a front landing gear 25a and a rear landing gear 25b, but only a single vertical stabilizer 26 at the rear end of the fuselage aligned with its longitudinal axis. It will be appreciated however, that vehicle 20 illustrated in Fig 2 could also include a pair of vertical stabilizers, as shown at 16a and 16b in Fig. 1, or could be constructed without any such aerodynamic stabilizing surface.

Fig. 3 illustrates a vehicle 30 also including a fuselage 31 of a very simple construction having a forward mounting structure 31a for mounting the forward lift-producing propeller 32a, and a rear mounting structure 31b for mounting the rear lift-producing propeller 32b. Both propellers are unducted, i.e., free, propellers. Fuselage 31 is formed centrally thereof with a pilots compartment 33 and carries the two payload bays 34a, 34b on its opposite sides laterally of the pilot's compartment.

Vehicle 30 illustrated in Fig. 3 also includes a front landing gear 35a and a rear landing gear 35b, but for simplification purposes, it does not include an aerodynamic stabilizing surface corresponding to vertical stabilizers 16a, 16b in Fig. 1.

Fig. 4 illustrates a vehicle, generally designated 40, of a similar construction as in Fig. 2 but including a fuselage 41 mounting a pair of unducted propellers 42a, 42b at its front end, and a pair of unducted propellers 42c, 42d at its rear end by means of mounting structures 41a – 41d, respectively. Vehicle 40 further includes a pilot's compartment 43 centrally of the fuselage, a pair of payload bays 44a, 44b laterally of the pilot's compartment, a front landing gear 45a, a rear landing gear 45b, and a vertical stabilizer 46 at the rear end of the fuselage 41 in alignment with its longitudinal axis.

Fig. 5 illustrates a vehicle, generally designated 50, including a fuselage 51 mounting a pair of lift-producing propellers 52a, 52b at its front end, and another pair 52c, 52d at its rear end. Each pair of lift-producing propellers 52a, 52b and 52c, 52d is enclosed within a common oval-shaped duct 52e, 52f at the respective end of the fuselage.

Vehicle 50 illustrated in Fig. 5 further includes a pilot' compartment 53 formed centrally of the fuselage 51, a pair of payload bays 54a, 54b laterally of the pilot's compartment 53, a front landing gear 55a, a rear landing gear 55b, and vertical stabilizers 56a, 56b carried at the rear end of the fuselage 51.

Figs. 6a, 6b and 6c are side, top and rear views, respectively, of another vehicle constructed in accordance with the present invention. The vehicle illustrated in Figs. 6a – 6c, therein generally designated 60, also includes a fuselage 61 mounting a lift-producing propeller 62a, 62b at its front and rear ends, respectively. The latter propellers are preferably ducted units as in Fig. 1.

Vehicle 60 further includes a pilot's compartment 63 centrally of the fuselage 61, a pair of payload bays 64a, 64b laterally of the fuselage and of the pilot's compartment, a front landing gear 65a, a rear landing gear 65b, and a stabilizer, which, in this case, is a horizontal stabilizer 66 extending across the rear end of the fuselage 61.

Vehicle 60 illustrated in Figs. 6a – 6c further includes a pair of pusher propellers 67a, 67b, mounted at the rear end of the fuselage 61 at the opposite ends of the horizontal stabilizer 66. As shown particularly in Figs. 6c the rear end of the fuselage 61 is formed with a pair of pylons 61a, 61b, for mounting the two pusher propellers 67a, 67b, together with the horizontal stabilizer 66.

The two pusher propellers 67a, 67b are preferably variable-pitch propellers enabling the vehicle to attain higher horizontal speeds. The horizontal stabilizer 66 is used to trim the vehicle's pitching moment caused by the ducted fans 62a, 62b, thereby enabling the vehicle to remain horizontal during high speed flight.

Each of the pusher propellers 67a, 67b is driven by an engine enclosed within the respective pylon 61a, 61b. The two engines are preferably turbo-shaft engines. Each pylon is thus formed with an air inlet 68a, 68b at the forward end of the respective pylon, and with an air outlet (not shown) at the rear end of the respective pylon.

Fig. 7 schematically illustrates the drive within the vehicle 60 for driving the two ducted fans 62a, 62b as well as the pusher propellers 67a, 67b. The drive system, generally designated 70, includes two engines 71, 71b, each incorporated in an engine compartment within one of the two pylons 61a, 61b. Each engine 71a, 71b, is coupled by an over-running clutch 72a, 72b, to a gear box 73a, 73b coupled on one side to the respective thrust

propeller 67a, 67b, and on the opposite side to a transmission for coupling to the two ducted fans 62a, 62b at the opposite ends of the fuselage. Thus, as schematically shown in Fig. 7, the latter transmission includes additional gear boxes 74a, 74b coupled to rear gear box 75b for driving the rear ducted fan 62b, and front gear box 75a for driving the front ducted fan 62b.

Fig. 8 pictorially illustrates an example of the outer appearance that vehicle 60 may take.

In the pictorial illustration of Fig. 8, those parts of the vehicle which correspond to the above-described parts in Figs. 6a – 6c are identified by the same reference numerals in order to facilitate understanding. Fig. 8, however, illustrates a number of additional features which may be provided in such a vehicle.

Thus, as shown in Fig. 8, the front end of the fuselage 61 may be provided with a stabilized sight and FLIR (Forward Looking Infra-Red) unit, as shown at 81, and with a gun at the forward end of each payload bay, as shown at 82. In addition, each payload bay may include a cover 83 deployable to an open position providing access to the payload bay, and to a closed position covering the payload bay with respect to the fuselage 61.

In Fig. 8, cover 83 of each payload bay is pivotally mounted to the fuselage 61 along an axis 84 parallel to the longitudinal axis of the fuselage at the bottom of the respective bay. The cover 83, when in its closed condition, conforms to the outer surface of the fuselage 61 and is flush therewith. When the cover 83 is pivoted to its open position, it serves as a support for supporting the payload, or a part thereof, in the respective payload bay.

The latter feature is more particularly shown in Figs. 8a – 8d which illustrate various task capabilities of the vehicle as particularly enabled by the pivotal covers 83 for the two payload bays. Thus, Fig. 8a illustrates the payload bays used for mounting or transporting guns or ammunition 85a; Fig. 8b illustrates the use of the payload bays for transporting personnel or troops 85b; Fig. 8c illustrates the use of the payload bays for transporting cargo 85c; and Fig. 8d illustrates the use of the payload bays for evacuating wounded 85d. Many other task or mission capabilities will be apparent.

Figs. 9a and 9b are side and top views, respectively, illustrating another vehicle, generally designated 90, of a slightly modified construction from vehicle 60 described

above. Thus, vehicle 90 illustrated in Figs. 9a and 9b also includes a fuselage 91, a pair of ducted-fan type lift-producing propellers 92a, 92b at the opposite ends of the fuselage, a pilot's compartment 93 centrally of the fuselage, and a pair of payload bays 94a, 94b laterally of the pilot's compartment 93. Vehicle 90 further includes a front landing gear 95a, a rear landing gear 95b, a horizontal stabilizer 96, and a pair of pusher propellers 97a, 97b, at the rear end of fuselage 91.

Fig. 10 schematically illustrates the drive system in vehicle 90. Thus as shown in Fig. 10, vehicle 90 also includes two engines 101a, 101b for driving the two ducted fans 92a, 92b and the two pusher propellers 97a, 97b, respectively, as in vehicle 60. However, whereas in vehicle 60 the two engines are located in separate engine compartments in the two pylons 61a, 61b, in vehicle 90 illustrated in Figs. 9a and 9b both engines are incorporated in a common engine compartment, schematically shown at 100 in Fig. 9a, underlying the pilot's compartment 93. The two engines 101a, 101b (Fig. 10), may also be turbo-shaft engines as in Fig. 7. For this purpose, the central portion of the fuselage 91 is formed with a pair of air inlet openings 98a, 98b forward of the pilot's compartment 93, and with a pair of air outlet openings 99a, 99b rearwardly of the pilot's compartment.

As shown in Fig. 10, the two engines 101a, 101b drive, via the over-running clutches 102a, 102b, a pair of hydraulic pumps 103a, 103b which, in turn, drive the drives 104a, 104b of the two pusher propellers 97a, 97b. The two engines 101a, 101b are further coupled to a drive shaft 105 which drives the drives 106a, 106b of the two ducted fans 92a, 92b, respectively.

Figs. 11a – 11d illustrate another vehicle, therein generally designated 110, which is basically of the same construction as vehicle 60 described above with respect to Figs. 6a – 6c, 7, 8 and 8a – 8d; to facilitate understanding, corresponding elements are therefore identified by the same reference numerals. Vehicle 110 illustrated in Figs. 11a – 11d, however, is equipped with two stub wings, generally designated 111a, 111b, each pivotally mounted to the fuselage 61, under one of the payload bays 64a, 64b, to a retracted position shown in Figs. 11a and 11b, or to an extended deployed position shown in Figs. 11c and 11d for enhancing the lift produced by the ducted fans 62a, 62b. Each of the stub wings 111a, 111b is actuated by an actuator 112a, 112b driven by a hydraulic or electrical motor (not shown). Thus, at low speed flight, the stub wings

111a, 111b, would be pivoted to their stowed positions as shown in Figs. 11a and 11b; but at high speed flight, they could be pivoted to their extended or deployed positions, as shown in Figs. 11c and 11d, to enhance the lift produced by the ducted fans 61a, 61b. Consequently, the blades in the ducted fans would be at low pitch producing only a part of the total lift force.

The front and rear landing gear, shown at 115a and 115b, could also by pivoted to a stowed position to enable higher speed flight, as shown in Figs. 11c and 11d. In such case, the front end of the fuselage 61 would preferably be enlarged to accommodate the landing gear when in its retracted condition. Vehicle 110 illustrated in Figs. 11a – 11d may also include ailerons, as shown at 116a, 116b (Fig. 11d) for roll control.

Fig. 12 illustrates how the vehicle, such as vehicle 60 illustrated in Figs. 6a – 6d, may be converted to a hovercraft for travelling over ground or water. Thus, the vehicle illustrated in Fig. 12, and therein generally designated 120, is basically of the same construction as described above with respect to Figs. 6a – 6d, and therefore corresponding parts have been identified with the same reference numerals. In vehicle 120 illustrated in Fig. 12, however, the landing gear wheels (65a, 65b, Figs. 6a – 6d) have been removed, folded, or otherwise stowed, and instead, a skirt 121 has been applied around the lower end of the fuselage 61. The ducted fans 62a, 62b, may be operated at very low power to create enough pressure to cause the vehicle to hover over the ground or water as in hovercraft vehicles. The variable pitch pusher propellers 67a, 67b would provide forward or rear movement, as well as steering control, by individually varying the pitch, as desired, of each propeller.

Vehicles constructed in accordance with the present invention may also be used for movement on the ground. Thus, the front and rear wheels of the landing gears can be driven by electric or hydraulic motors included within the vehicle.

Fig. 13 illustrates how such a vehicle can also be used as an ATV (all terrain vehicle). The vehicle illustrated in Fig. 13, therein generally designated 130, is basically of the same construction as vehicle 60 illustrated in Figs. 6a – 6d, and therefore corresponding parts have been identified by the same reference numerals to facilitate understanding. In vehicle 130 illustrated in Fig. 13, however, the two rear wheels of the vehicle are replaced by two (or four) larger ones, bringing the total number of wheels per vehicle to four (or

six). Thus, as shown in Fig. 13, the front wheels (e.g., 65a, Fig. 6c) of the front landing gear are retained, but the rear wheels are replaced by two larger wheels 135a (or by an additional pair of wheels, not shown), to enable the vehicle to traverse all types of terrain.

When the vehicle is used as an ATV as shown in Fig. 13, the front wheels 65a or rear wheels would provide steering, while the pusher propellers 67a, 67b and main lift fans 62a, 62b would be disconnected but could still be powered-up for take-off if so desired. The same applies also with respect to the hovercraft version illustrated in Fig. 12.

It will thus be seen that the invention thus provides a utility vehicle of a relatively simple structure which is capable of performing a wide variety of VTOL functions, as well as many other tasks and missions, with minimum changes in the vehicle to convert it from one task or mission to another.

Figs. 14a-14e are pictorial illustrations of alternative vehicle arrangements where the vehicle is relatively small in size, having the pilot's cockpit installed to one side of the vehicle. Various alternative payload possibilities are shown.

Fig. 14a shows the vehicle in its basic form, with no specific payload installed. The overall design and placement of parts of the vehicle are similar to those of the 'larger' vehicle described in Figs. 8. with the exception of the pilot's cockpit, which in the arrangement of Fig.14 takes up the space of one of the payload bays created by the configuration shown in Fig.8. The cockpit arrangement of Fig. 14a frees up the area taken up by the cockpit in the arrangement of Fig.8 for use as an alternative payload area, increasing the total volume available for payload on the opposite side of the cockpit. It is appreciated that the mechanical arrangement of engines, drive shafts and gearboxes for the vehicle of Fig. 14. may be that described with reference to Fig. 7.

Fig. 14b illustrates how the basic vehicle of Fig. 14a may be used to evacuate a patient. The single payload bay is optionally provided with a cover and side door which protect the occupants, and which may include transparent areas to enable light to enter. The patient lies on a stretcher which is oriented predominantly perpendicular to the longitudinal axis of the vehicle, and optionally at a slight angle to enable the feet of the patient to clear the pilot's seat area and be moved fully into the vehicle despite its small size. Space for a medical attendant is provided, close to the outer side of the vehicle.

Fig. 14c shows the vehicle of Fig. 14b with the cover and side door closed for flight.

Fig. 14d illustrates how the basic vehicle of Fig. 14a may be used to perform various utility operations such as electric power-line maintenance. In the example shown if Fig. 14d, a seat is provided for an operator, facing outwards towards an electric power-line. For illustration purposes, the operator is shown attaching plastic spheres to the line using tools. Uninstalled sphere halves and additional equipment may br carried in the open space behind the operator. Similar applications may include other utility equipment, such as for bridge inspection and maintenance, antenna repair, window cleaning, and other applications. One very important mission that the utility version of Fig. 14d could perform is the extraction of survivors from hi-rise buildings, with the operator assisting the survivors to climb onto the platform while the vehicle hovers within reach.

Fig. 14e illustrates how the basic vehicle of Fig. 14a may be used to carry personnel in a comfortable closed cabin, such as for commuting, observation, performing police duties, or any other purpose.

Fig. 15 is a pictorial illustration of a vehicle constructed typically in accordance with the configuration in Fig. 14 but equipped with a lower, flexible skirt for converting the vehicle to a hovercraft for movement over ground or water. While the vehicle shown in Fig.15 is similar to the application of Fig. 14e, it should be mentioned that a skirt can be installed on any of the applications shown in Fig. 14.

While Figs. 14-15 show a vehicle having a cockpit on the left hand side and a payload bay to the right hand side, it is appreciated that alternative arrangements are possible, such as where the cockpit is on the right hand side and the payload bay is on the left hand side. All the descriptions provided in Figs. 14-15 apply also to such an alternative configuration.

While the invention has been described with respect to several preferred embodiments, it will be appreciated that these are set forth merely for purposes of example, and that many other variations, modifications and applications of the invention will be apparent.